

Project Title: Detailed study of Cape Sable seaside sparrow nest success and causes of nest failure: 1st Quarter Report, 7 April 2005.

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Executive Summary

- This report details the initial field season of a three-year project devoted to understanding the breeding distribution and biology of Cape Sable seaside sparrows within small subpopulations (C and F).
- The logistics of surveying for sparrows along 2km transects in subpopulations C and F are manageable, and we foresee few problems continuing this effort for the duration of the project. These transects followed closely the lay-out of the extensive survey, thus providing independent confirmation of assessments made using extensive survey data.
- The transect surveys turned up very few sparrows. This reflects the following issues; (1) sparrows are thought to be rare in these habitats and our surveys confirm this, (2) our surveys were set 1km apart thus we may have failed to survey areas that did hold sparrows, and (3) male sparrows may not sing unless prompted by a neighboring individuals, thus introducing the possibility that sparrows were present along our surveys but went undetected by us.
- The transect survey will be modified in the coming years to eliminate influences on numbers of sparrows counted, beyond their inherent rarity in this habitats. In particular, surveys will be concentrated into areas where we suspect sparrows may be found (i.e. eliminate transects that clearly ran through unsuitable habitat), conduct them at a finer resolution, and use tape-recordings of sparrow songs to prompt males to sing and thus be counted by us.
- The interplay between the surveys and the establishment of study plots designed to collect demographic information worked flawlessly. Although not planned for this season, we managed to band male sparrows in subpopulation C.
- We anticipate few monetary or logistical issues with the continuation of the surveys in the coming field season (March 2006), and with stepping up efforts to band sparrows and monitor their nests within subpopulations C and F.

Overview

The Cape Sable Seaside Sparrow has become a signature species for the Everglades and its restoration (Lockwood et al. 2003). The sparrow is restricted to short-hydroperiod marl prairies that are distributed throughout the southern Everglades ecosystem. The fate of these prairies, and the sparrow, is intimately tied to the seasonal timing and spatial extent of water flows through the Everglades. Ill-timed water flows and associated changes in fire regimes (Pimm et al. 2002, Lockwood et al. 2003) have lead to a 50% decline in sparrow numbers since 1993 (Pimm et al. 2002). Of recent concern is the loss of small, spatially isolated subpopulations (Pimm et al. 2002, Pimm and Bass 2003). For example, subpopulations A, C, D, and F have each experienced declines of 70% or more since 1981, with subpopulation D apparently having been recently extirpated, and A and

F currently teetering on the brink of extinction (O.L. Bass jr pers. com.; Pimm et al. 2002). The systematic loss of sparrow subpopulations increases the risk of extinction for the subspecies by concentrating the remaining individuals into one geographic location (Holmes et al. 1996). Thus, the need to realize significant recovery of sparrow numbers within the remaining small subpopulations is acute.

Subpopulations C and F are located in the most easterly section of Everglades National Park (ENP). Each subpopulation now contains less than a quarter of the number of individuals observed there in 1981 (Pimm et al. 2002). Pimm et al. (2002) suggest that habitat in these areas has suffered from over-drying due to the Central and South Florida Project. The lack of regular seasonal water inundation and the frequency of human-caused ignitions has allowed habitat within subpopulations C and F to burn almost yearly through the years 1980-1998 (Curnutt et al. 1998). [Note that there is a small area of subpopulation C that is located south of the Taylor Slough Bridge that no longer holds sparrows because of an increased hydroperiod resulting from the installation of a water pumping station nearby; see Nott et al. 1998 for details.] As a result sparrow numbers in subpopulation F have declined from a high of an estimated 122 individuals in 1981 to a current estimated low of between 15 to 30 individuals. Subpopulation C held an estimated 432 sparrows in 1981 and since then has hovered between an estimated 40 to 100 individuals (Pimm et al. 2002). Since 1998, ENP fire management has suppressed most fires within these subpopulations and begun burning buffer strips along the ENP boundary to reduce the likelihood of arson fires burning into sparrow habitat. This effort has prevented most fires from burning into sparrow habitat since 1999 (PI, unpublished data). Recent ENP sparrow surveys provide some indication that fire suppression is promoting sparrow persistence, however there has been no significant recovery since the initial loss of numbers post-1981 (Pimm et al. 2002).

Often when avian (and other vertebrate) populations reach such low densities as observed in subpopulations C and F their long-term persistence and potential to recover is inordinately influenced by intrinsic social limitations and an increased susceptibility to environmental fluctuations (Holmes et al. 1996). Ecologists now recognize myriad behavioral and social mechanisms that fully function only when there are sufficient numbers of interacting individuals. These limitations are often collectively termed Allee Effects (Courchamp et al. 1999). Among birds, low population sizes often make it difficult (1) for breeding adults to find each other to mate, (2) to assess the condition of potential breeding habitat and (3) to ward off predators of adults and nests (Reed 1997, Etterson 2003). Each of these effects has the potential to severely limit nesting success and annual fecundity. Independent of these social limitations, small populations are more vulnerable to environmental fluctuations (e.g., Grevstad 1999). This principle derives from a simple understanding of probabilities. The more individuals there are in a population, the less likely all of them will die, or fail to breed, during a single harmful environmental event (e.g., flood or fire). Combining the two small-population problems leaves the possibility that environmental factors serve to lower the number of individuals to the point that social and behavioral dynamics limit future population growth by restricting breeding success and reducing juvenile and adult survival (Reed 1997). It is possible that the past, large reductions in sparrow numbers of >70% in some subpopulations could have triggered such limitations to recovery. This is particularly worrisome since Lockwood et al. (2001) found that nest success rates and length of

breeding season were the principle drivers to population growth for the Cape Sable seaside sparrow.

If this is the case with Cape Sable seaside sparrows, then as with other species that are recovering from substantial population reductions (Gardmark et al. 2003), cessation of the primary threats (in this case, fire or excess flooding) will not automatically ensure recovery. While it is still vital to continue to ameliorate these threats, the failure to see significant recovery following management changes suggests that sparrow recovery may be limited by factors that will only become apparent when sparrows are driven to excessively low numbers. The research under this funding will provide this information for two such subpopulations (C and F), and compare their situation to that of the two larger subpopulations (B and E). In particular, the described research will provide information on the nest success, mating status, and breeding season spatial distribution of sparrows that exist within low-density situations. By providing this information, we can begin to uncover factors that may be inhibiting the full recovery of small sparrow subpopulations and, ultimately, the entire subspecies.

In addition, this research will allow us to explore two secondary components of sparrow recovery. First, we can determine the subpopulation of origin of sparrows observed breeding in subpopulations C and F. Recent fieldwork has indicated that, at least occasionally, sparrows within subpopulations B and E disperse into subpopulation A (PI, pers obs). This proposal will integrate with existing (funded) marking efforts within subpopulations B and E, allowing us to expand our knowledge of dispersal. We can thus ascertain if sparrows are dispersing in a directional manner (that is, out of large subpopulations and into small ones), and if there is dispersal into (or out of) the eastern subpopulations at all. Second, the detailed surveys within C and F will allow us to preliminarily assess the accuracy of the annual extensive helicopter survey within areas that harbor very few individuals (<10 sparrows have been visually located within C and F since 1992; Pimm et al. 2002). Such an assessment is critical if we are to accurately monitor the status of these small subpopulations and evaluate the success of future management actions (e.g., Comprehensive Everglades Restoration Project; CERP).

Description of Work Completed to Date

Survey Protocol

Our study design has two principle protocols. The first protocol is a systematic ground-based survey of subpopulations C and F. Our ground-based survey consists of 100m width strip transects that are each 2km in length. Our goal is to sample at least 20km within each subpopulation. This represents greater than 70% of the total area of each subpopulation. We record the distance to each sparrow visually detected using a laser rangefinder, and we calculate the angle the sparrow sits away from the transect line using a hand-held GPS unit. The strip transects generally follow the Cape Sable seaside sparrow extensive survey grid and will be logged into a GIS system such that the same transects will be revisited annually. This distance sampling protocol allows us to generate relatively precise annual estimates of sparrow density (Buckland et al. 2001). Also, distance sampling allows us to annually model detection probability within a low-density subpopulation. This latter product will allow us to compare the results from our strip-transect surveys to the annual extensive helicopter survey and thus evaluate the accuracy of the range-wide survey in estimating abundance in these small sparrow

subpopulations. Finally, by utilizing a GPS unit that is capable of projecting a UTM waypoint that corresponds to the sparrows we detect, we can annually produce a spatial distribution map of sparrows within a GIS framework. This allows us the further capability of tracking changes in spatial arrangement of breeding individuals over the three-year span of the proposed project.

The information gained from this first protocol provides (1) a detailed map of the annual distribution of sparrows within subpopulations C and F (2) a precise estimate of the density of sparrows in subpopulations C and F (3) information necessary to evaluate changes in distribution or density of sparrows in these subpopulations over a three year span, and (4) a calibration dataset for comparison to the extensive survey and for efforts at characterizing and predicting changes in sparrow habitat within these subpopulations.

Funding for this project arrived at Rutgers University in early February 2005. We immediately purchased the necessary equipment to conduct line transect surveys within subpopulations C and F. This included Garmin eTrex Vista Global Positioning Units, two-way radios, laser rangefinders, monopods, and other small equipment. A crew of 6 individuals, all having at least one full season of experience working with Cape Sable seaside sparrows, began the line transect surveys on March 14th, 2005. This crew included the following individuals: Dr. Julie Lockwood, Michelle Davis, David La Puma, Mandy Holmgren, Blake Mathys, and Ben Baiser. Each transect survey began no later than 0730 and ended no later than 0900. This time frame ensures that the surveys were conducted when conditions were optimal for the detection of individual sparrows. Early morning hours typically have low to no wind, and sparrows are known to sing most often in these hours of the day (Pimm et al. 2001).

Each member of the survey team carried with them a laser rangefinder mounted on a monopod. This ensured that the rangefinder could be held steady while survey members accurately calculated the distance from themselves to each detected sparrow. Also, the Garmin eTrex Vista GPS units allowed us to maintain a constant straight line transect course, estimate our speed of travel along that course, project a waypoint to any sparrows detected, and estimate the angle that the detected sparrow sat off the transect line. Each of these features is necessary to produce accurate estimates of density according to distance sampling protocols. All equipment performed very well and we are confident that our choice of equipment will enable us to efficiently repeat surveys over the span of this study.

We found that each survey member could easily cover 2km of transect length each morning. Each transect lies 1km from its neighbor and follows the layout of the extensive survey (i.e. we were essentially 'connecting the dots' between extensive survey locations; Figures 1 and 2). Thus, we surveyed 12km of sparrow habitat each morning. We were able to sample all established extensive survey points and transect lines in between them (Figures 1 and 2). We therefore exceeded our goal of surveying 20km within subpopulations C and F, ultimately surveying 23km within subpopulation F and 27km within subpopulation C. Furthermore, we were able to complete the entire survey within the span of 6 days. This bodes well for future surveys, and suggests the funding allocated for the surveys is sufficient. This also suggests that we will be able to either (1) increase the resolution of the survey (see below) or (2) survey sections of other subpopulations for comparison to our results in C and F. For example, this year two survey members conducted counts within subpopulation B, which holds a large number

of sparrows. This provided important information regarding our chosen methodology (see below), and in the future the ability to expand surveys into subpopulation B will allow us to compare detection rates and density estimates between large and small sparrow subpopulations.

Despite the logistical ease with which we could conduct the surveys, we detected only three sparrows. All of these were within subpopulation C (Figure 1). We heard sparrows within other sections of subpopulation C and at one site at F. However, these sparrows were not incorporated into our estimates of population density since we could not estimate the distance to these individuals. Such a small number of sparrow detections made it impossible to estimate density.

The lack of sparrow detections has several implications. The first, and simplest to overcome, is that our methodology requires modification. There are three ways in which we may need to modify our methodology for future survey.

- (1) Cape Sable seaside sparrows are known to be rare and sparsely distributed within these subpopulations. Indeed, that is the basis of our study. Thus, we will likely increase the spatial resolution of our surveys in future years and likely space transects 500m apart (or smaller if need be). This will naturally increase the likelihood that we encounter sparrows if they are present.
- (2) We may also need to use tape recordings of the sparrow's song to prompt males to perch atop grass stems and sing. This behavior is required if we are to detect them and estimate their distance from the transect line. Our experience this year in conducting the survey methodology in densely populated areas in B is that we can detect up to 5 sparrows per kilometer of transect. This suggests that the methodology is plenty capable of counting sparrows, when they are singing. In densely populated habitat, males are typically counter-singing (i.e. singing in response to their neighbor's singing). In sparsely populated habitats where there may be few males to cue off of, we may need to 'prompt' resident sparrows into singing by providing a taped counterpart. We will likely adopt this methodology in future surveys.

The second implication of our failure to detect many sparrows is that there simply are not many sparrows left in these areas. Given our success in detecting and counting sparrows using this methodology within the more densely populated subpopulation B, we are confident that if sparrows were near us within subpopulations C and F, we would have heard them and counted them. Indeed, we sometimes found ourselves walking through habitat that was clearly not suitable for sparrows despite the fact that sparrows were detected by the extensive survey in, or very near, these areas over the span of the last 10 or more years. For example, in the upper portion of subpopulation F and the extreme southeast corner of subpopulation C (Figures 1 and 2), we were bushwhacking through willow stands and encountering significant woody vegetation. We also regularly encountered recently treated stands of exotic hardwood trees that, although clearly dead, remained upright. Thus, some portion of habitat within subpopulations C and F is no longer suitable for sparrows. Given the need to move to a finer resolution survey (see above), and the goals associated with the second protocol in this study (see below), we will likely narrow the locations in which we survey in the future to include only sites that are somewhat, or very, likely to hold sparrows.

There were other sections of subpopulations C and F that, to our eyes, looked suitable for sparrows, but in which we detected none. This result is more puzzling. We will focus our fine-resolution survey efforts on these apparently suitable areas in future years. It remains to be seen whether, in these locations, sparrows are truly absent or whether they are present in such low numbers that we simply did not detect them in this our first effort at surveying these sites. The answer to this question (i.e. are they present but rare, or absent) will greatly influence how we proceed in conducting the second protocol, described below.

Demography Protocol

The second protocol is a comprehensive effort to document nesting success, length of breeding season, and mating status of individuals in subpopulations C and F. Based on the strip transect information collected above, we will annually establish two to three 1km² study plots within subpopulations C and F. Within these plots we will (1) find and monitor active sparrow nests (2) color band adult and nestling sparrows (3) define the territories of breeding sparrows using GIS and (4) log the geographic positions of all color banded sparrows. Repeating these procedures over the span of 3 years allows the following to be estimated; (1) fecundity, (2) survivorship, (3) dispersal (young and adults), (4) site fidelity (i.e. annual locations of breeding territories) (5) territory size and shape (6) nest predation rates and other information related to nest failure and (7) mating status of banded individuals. We will continue these efforts in each subpopulation for a minimum of two breeding seasons.

This second protocol has been utilized successfully by the PI within subpopulations B and E between 1995 and the present (Lockwood et al. 2001, Lockwood 2004), and thus similar information is available for sparrows breeding in high-density situations. The PI has records for over 300 Cape Sable seaside sparrow nests found within subpopulations B and E. This amount of information, and the temporal time span it encompasses, allows an estimation of the mean and variability around the same set of breeding season variables as will be collected in subpopulations C and F. This allows for a powerful comparison of fecundity, survivorship, dispersal, site fidelity, territory size, nest predation and mating status between small and large subpopulations. After conducting this comparison, we can provide a basis for assessing the long-term viability of small sparrow subpopulations. If we conclude that subpopulations C and F have low probability of long-term viability, the detailed demographic information collected will also allow us to pinpoint obstacles to full recovery including, (1) failure to breed (2) skewed age or sex ratio (3) altered habitat components (e.g., invasion of exotic trees or woody hardwood species) (3) increased nest loss due to predation or high water depths (4) lack of dispersal opportunities for young and (5) unusually high mortality of adults or young. Finally, since marking (banding) efforts will be conducted concurrently within subpopulations A, E and B during the duration of the work proposed here (by the PI and by S.L. Pimm), we will pay special attention to identifying any individuals that breed in C and F that were marked within other subpopulations. It is also possible that the individuals we mark will disperse into subpopulations A, E or B. Thus, this proposal extends the probability of documenting dispersal events well beyond what is currently likely, and thus our collective efforts will be able to better track movements between nearly all sparrow subpopulations.

This protocol was designed to begin in the second year of our study, however, we were able to locate and band two individuals within subpopulation C (Figure 1). As expected, we used the results from the transect survey to suggest where to concentrate our efforts at banding. In this case, we heard these sparrows during our transect surveys, but did not count them. We expect that as we refine our transect survey methodology this synergistic interaction between protocols will continue.

Summary and Future Plans

Our first effort at documenting the breeding distribution and biology of Cape Sable seaside sparrows within the small eastern subpopulation (C and F) went very well. The equipment performed as expected and we found few logistical constraints to our transect surveys. We exceeded our goal of surveying 20km of habitat within subpopulations C and F, and we managed to band two males within subpopulation C. Furthermore, we can successfully finish our surveys within the span of one to two weeks provided that there are 6 members of the survey team active during that period. Each of these more logistical results has important implications for our ability to step-up survey effort in the coming years and begin detailed work on the demography of sparrows living in these small subpopulations. In particular, we are now confident that we can survey for sparrows throughout subpopulations C and F in an efficient manner, map the distribution of sparrows in these subpopulations, and begin banding and nest monitoring in occupied habitat by early April in coming years.

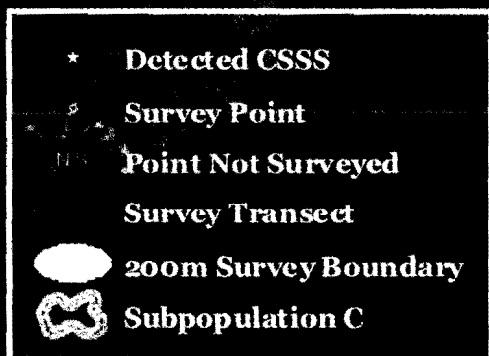
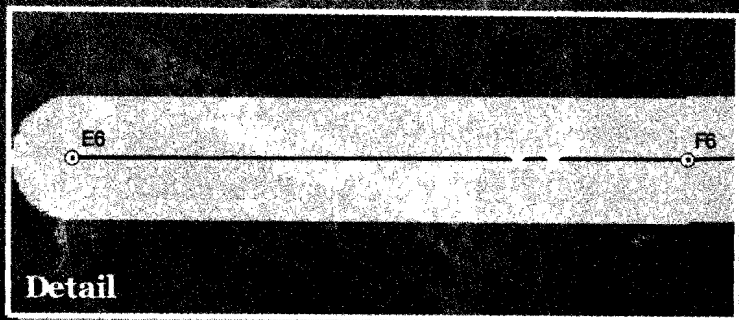
We detected few sparrows along our survey transects, which reflects the small number of sparrows in these subpopulations. However, we also suspect that we had low numbers of detections due to the spatial resolution of the survey (1km between transects) and the behavior of sparrows when not surrounded by other individuals (no counter-singing). Thus, all future surveys will be conducted at a finer spatial resolution (500m between transects) and using tape-recordings of the sparrow's song as a 'prompt' for male sparrows to sing and thus be counted by our survey crew. We will compensate for the time it will take to run the surveys at a fine resolution by not repeating surveys along transects that we found this year to clearly run through unsuitable habitat. Finally, we expect to establish study plots within subpopulations C and F in the next breeding season (starting March 2006), and band individuals and monitor nests within these plots.

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Cape Sable Seaside Sparrow Subpopulation C

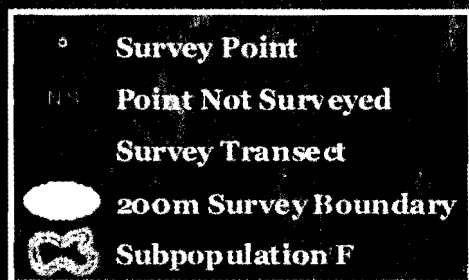
Small Population Study: 2005 Survey Results



1
scale in kilometers

Cape Sable Seaside Sparrow Subpopulation F

Small Population Study:
2005 Survey Results



1
scale in kilometers

